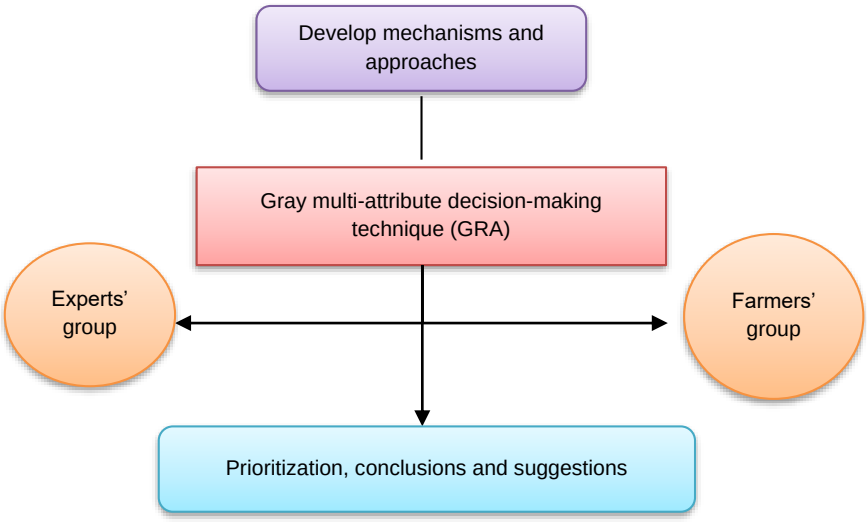
Journal of Applied Research in Water and Wastewater
E-ISSN: 2476-6283
Journal homepage: https://arww.razi.ac.ir

Developing mechanisms and approaches for the sustainable development of agriculture in Sistan and Baluchestan province with an emphasis on drought

Ali Sardar Shahraki[1,*], Mahdi Safdari[1], Ebrahim HamidZadeh[1], Mawladad Khairi[2]

[1]*Department of Agricultural Economics, Faculty of Management and Economics, University of Sistan and Baluchestan, Zahedan, Iran.*
[2]*Department of Agricultural Economics and Extention, Faculty of Agriculture, Faryab University, Faryab, Afghanistan.*

GRAPHICAL ABSTRACT



ARTICLE INFO

Article type:
Research Article

Article history:
Received 13 January 2025
Received in revised form 25 March 2025
Accepted 10 April 2025
Available online 1 June 2025

Keywords:
Agricultural development
Sistan and Baluchestan province
Strategy
Sustainability
Drought

ABSTRACT

All-inclusive growth in all sectors along with structural reforms in institutions can lead to development. In this regard, the agricultural sector plays a key role in the development of Iran owing to its specific status. The development of the agricultural sector with a sustainability approach can greatly contribute to the development of other sectors, too. In this respect, Sistan and Baluchestan province has a special role to play in the regional economy due to its specific climatic and geographical conditions for agriculture. Therefore, this research aimed to formulate mechanisms and strategies for the development of sustainable agriculture in this province. The research adopted the gray multi-attribute decision-making technique (GRA) for modeling. Data were collected with a questionnaire filled out by experts and farmers in 2020. Based on this, 5 options and 28 indicators were finalized based on the opinions of expert experts. The software package of MCDMSOLVER.2018 was used for modeling. The results derived from the experts showed that choice taxing resource-intensive and polluting agricultural activities was ranked the top with a final score of 0.8134. Also, the use of cooperative methods and processes in the development and extension of sustainable agricultural activities was ranked second with a score of 0.71. The next ranks were for educating farmers and supporting their membership in sustainable agriculture groups and providing specific research and support services in the field of sustainable agriculture with scores of 0.571 and 0.519, respectively. The lowest ranks were assigned to Adjusting the price of products in the market in favor of healthy and ecological products, encouraging and attracting the cooperation of private and non-governmental national and international institutions in the field of sustainable agriculture, such as FAO or the Global Environment Facility and social security and retirement insurance for farmers with scores of 0.334, 0.333, and 0.298, respectively. The farmers ranked taxing on resource-intensive and polluting agricultural activities and using participatory methods and processes in the development and promotion of sustainable agricultural activities at the top with scores of 0.722 and 0.576, respectively.

1. Introduction

The term development can be used to refer to the improvement in the living level of all people in a country or region (Khairi *et al*., 2022). Although the escalation of crop production in recent decades has been successful in partially meeting the demands of the growing population, it has now been recognized that the use of conventional farming practices results in environmental degradation due to the excessive use of resources (water, land, and capital). Sustainable agriculture has, therefore, been proposed as a key to relieving these problems (Sardar

*Corresponding author Email: a.s.shahraki@eco.usb.ac.ir

Cite this article: A. Sardar Shahraki, M. Safdari, E. HamidZadeh, M. Khairi, Develop mechanisms and approaches for the sustainable development of agriculture in Sistan and Baluchestan province with an emphasis on drought, *Journal of Applied Research in Water and Wastewater*, 12 (1), 2025, 7-11. doi: https://doi.org/10.22126/arww.2025.8696.1279

Shahraki *et al*., 2016; Koocheki *et al*., 2013; Sardar Shahraki *et al*., 2018; Aliahmadi *et al*., 2021).

Agricultural development is an important priority in the national development plans of all developing countries. Despite several decades of efforts in this respect, the gap between developing and undeveloped countries has been deepened except for a few examples (Kiani Ghalehsard *et al*., 2021). On the other hand, there is heterogeneity in welfare, income, and various aspects of development even within developed countries, and marginalization is an essential issue. The adoption of policies that are based on economic growth, industrial renovation, technology transfer, and emphasis on increasing production and export has had adverse economic, social, and environmental consequences and has, in general, led to the unsustainability of the agricultural sector in most countries. The increasing growth of food imports in most third-world countries has become a grave source of concern (Ebrahimzadeh, 2009; 2021; Rakhshani *et al*., 2021; Moslemi *et al*., 2021).

Today, given the need for preventing the degradation of water and soil resources and alleviating its environmental, economic, and social damages, a key priority for the policymakers of the agricultural sector is to ensure agriculture sustainability and provide sustainable agricultural, horticultural, and animal farming patterns. In this regard, this research aims to develop mechanisms and strategies for sustainable agricultural development and propose sustainable agricultural, horticultural, and animal farming patterns for balancing the use of resources, minimizing the application of chemical fertilizers and pesticides, establishing a balance among available resources and climatic conditions, and optimally using them in Sistan and Baluchestan province, Iran. The agricultural sector is highly important in this province, so the investigation of the different aspects of sustainable agricultural development calls for numerous research studies. Indeed, the present research pursues to answer the following questions:

What strategy are required for the development of sustainable agriculture in Sistan and Baluchestan province?

What are the strategies for the development of sustainable agriculture in Sistan-va-Baluchestan province?

How can the strategies for the development of sustainable agriculture be prioritized in Sistan and Baluchestan province?

So, the research goals can be expressed as follows:

Developing mechanisms and approaches for the development of sustainable agriculture in Sistan and Baluchestan province

Presenting approaches for the sustainability of agricultural resources, including land, water, labor, and capital

The spatial and policy contributions of the research are the development of mechanisms and strategies for the sustainable development of agriculture and animal farming and the recommendation of proper agricultural, horticultural, and animal farming patterns for balancing the use of resources, establishing a balance among available resources and climatic conditions, and optimally using them in Sistan-va-Baluchistan province. The main feature of the research is its comprehensiveness and multi-facet view for reaching the goal, which is considered for the first time. The most important relevant research is reviewed below. Aimed to explain the role of water in sustainable development with an emphasis on agriculture, the researcher concludes that with optimal management of water resources using such approaches as the use of modern irrigation methods and climatically-consistent cultivation, not only can water be consumed optimally and can healthy food be produced in the agricultural sector but a significant role can also be played in the persistence and survival of Iranian society in the long run. The researchers aimed to investigate organic farming and its role in the sustainable development of agriculture. The paper uses the document and library methods to examine the concept and importance of sustainable agriculture, explain organic farming, and finally, describe the role of organic farming in sustainable agriculture development. The researchers make some recommendations. Rezaei *et al*. (2018) state that green entrepreneurship is presently known as an effective strategy for socioeconomic development, so its development in the agricultural sector can play a key role in creating sustainable employment, alleviating environmental issues, reducing diseases caused by the consumption of unsafe foodstuff, and enhancing the productivity of agricultural lands. The researchers aim to explain the role of green entrepreneurship as a new field in environmental conservation and economic and sustainable development in all societies. Among various farm management strategies, they propose the simultaneous use of precision agriculture, organic agriculture, and safe crop production as a solution for reducing the use of chemical inputs for the sake of ensuring in-farm crop safety and quality, increasing yields, enhancing economic productivity, and reducing adverse environmental impacts. Presently, sustainable development and food security should consider the optimal and correct use of natural resources. Therefore, sustainable agriculture uses sound and optimal management of agricultural resources to meet people's changing needs and enhance the environment and natural resources in regions where agriculture is the basis of economic activity. So, there seems to be an undeniable need to consider sustainable agriculture, which has a significant impact on environmental conservation. The excessive application of production inputs for yield enhancement in recent decades has destructed the environment and has made it more important to consider agricultural sustainability and continuous production along with the conservation of natural resources. The agricultural sector is one of the most important sectors influenced by climate change. Climate change is today the most important threat in all dimensions of sustainable development, including environmental dimensions, agriculture, and food security. However, researchers in Iran have not studied the approaches to reducing its impacts on crop yields and quality comprehensively. The approach of sustainable development has been proposed by the UN as a solution for environmental damages and the loss of people's general living level over the last three decades. To accomplish its missions including the supply of food security and to play its effective role in reinforcing national independence, the agricultural sector needs a rapid transition from subsistence and traditional production to industrial and commercial production. So, it needs to be developed by adopting proper measures. Economic machinery that can increase production capacity and standard and improve productivity is a key element of agricultural mechanization, and agricultural mechanization can improve efficiency and guarantee the effectiveness of measures throughout the process from crop production to processing and supply. Thus, it is consistent with the principles of sustainable development to select and apply proper techniques and use the facilities in research and economic process of crop production, processing, and supply soundly.

2. Methodology

A grey system is described by grey numbers, grey equations, and grey matrices. In which the grey numbers act as the atoms and cells of the system. A grey number can define a number with uncertainty. For example, the ranks of criteria in a decision-making process can be expressed with lingual variables that can be represented by numerical intervals. These intervals will contain uncertain information. In 1982, Deng Julong published his first article, Control problems of grey systems, on grey concepts and theory in the international journal of Control & Systems. He had extensive research on the prediction and control of economic systems and fuzzy systems and faced highly uncertain systems whose attributes could hardly be described by fuzzy mathematics or probability and statistics. Fuzzy mathematics generally deals with problems in which uncertainty is expressed by experts using discrete/continuous membership functions. On the other hand, probability and statistics need descriptive functions and sampling to achieve validity (Sardar Shahraki and Mohhamad Ghasemi, 2023). The grey systems were named after the color of the studied subjects. One good example is the black box, which refers to a piece in which all internal relations and structures are fully encoded and unknown. Here, the term "black" reflects that the information is unknown. "White" refers to fully known information, and "grey" refers to information that is partially known and partially unknown. Accordingly, systems with fully known information are called "white systems", those with fully unknown or no information are called "black systems", and those with partially known and partially unknown information are called "grey systems" (Taghavifard and Malek, 2011). The variables used in the research are presented in Tables 1 and 2.

Table 1. The criteria used in the research.

Criterion	Symbol
Economic sustainability	O1
Social sustainability	O2
Environmental sustainability	O3
Technical and infrastructural sustainability	O4
Promotional sustainability	O5

The advanced grey technique was used to achieve the research goal. In this technique, the opinions of experts should be used in several steps to collect the required information. So, a pre-built questionnaire was modified to derive criteria and sub-criteria based on the experts' opinions. Since the experts in this research were divided into two categories of farmers and experts, 25 participants were selected from each category to fill out the questionnaire. Based on this, 5 options and 28 indicators were finalized based on the opinions of expert experts. Data were analyzed by the MCDMSOLVER software suite (ver. 2018).

Table 2. Choices used in the research.

Choice	Symbol
Announcing and compiling a national document for the promotion and development of sustainable agriculture	C1
Granting the right of ownership or respecting the right of ownership to farmers who follow the principles of sustainable agriculture	C2
Encouraging and supporting farmer-to-farmer interactions and promotion methods to expand sustainable agriculture	C3
Guaranteed purchase of healthy and organic products	C4
Subjecting government and financial support to the implementation of resource protection and environment-friendly activities	C5
Adjusting the price of products in the market in favor of healthy and ecological products	C6
Taxing on resource-intensive and polluting agricultural activities	C7
Informing consumers and the general public about the health of sustainable agricultural products	C8
Encouraging and promoting the acceptance of environmental and natural resources audit to include the value of non-market services of soil and water resources in economic calculations	C9
Compiling appropriate standards and regulations for the use of pesticides and chemical fertilizers	C10
Encouraging the formation of local groups to promote sustainable agriculture	C11
Training farmers and supporting their membership in sustainable agriculture groups	C12
Providing incentives for employment in agriculture and other on-farm jobs	C13
Delegating local responsibilities of monitoring and protecting natural and agricultural landscapes to local people	C14
Providing the context for groups to access government support credits in the field of sustainable agriculture	C15
Encouraging and attracting the cooperation of private and non-governmental national and international institutions in the field of sustainable agriculture, such as FAO or the Global Environment Facility	C16
Using participatory methods and processes in the development and promotion of sustainable agricultural activities	C17
Shaping sustainable agricultural information systems to link farmers, extension agents, and researchers	C18
Providing the possibility of exporting safe and organic products	C19
Improving the capacities of non-governmental organizations active in the field of sustainable agriculture to expand the field of action	C20
Encouraging and facilitating joint efforts between the government and non-governmental organizations to promote sustainable agriculture	C21
Revising agricultural educational institutions to pay attention to the principles of sustainability in the content and process of education	C22
Creating a framework and compiling guidelines for labeling and certification of the production process as well as the crops produced in sustainable agriculture	C23
Providing special research and support services in the field of sustainable agriculture	C24
Compiling regulations, laws, and standards of sustainable agriculture by relevant institutions such as the Islamic Parliament or the Standard Institute	C25
Pursuing and promoting water productivity based on water input instead of land	C26
Safe and organic crop insurance	C27
Social security and retirement insurance for farmers	C28

3. Results and discussion

3.1. Results from experts' group

The final results of the grey technique based on the experts' opinions are shown in Table 5. Accordingly, C7 gained the highest final score of 0.8134 and was ranked first. Also, C17 was ranked second with a score of 0.71. The results show that C24 and C12 were in the next ranks with scores of 0.571 and 0.519, respectively. The last ranks were for C6, C16, and C28 with scores of 0.334, 0.333, and 0.298, respectively.

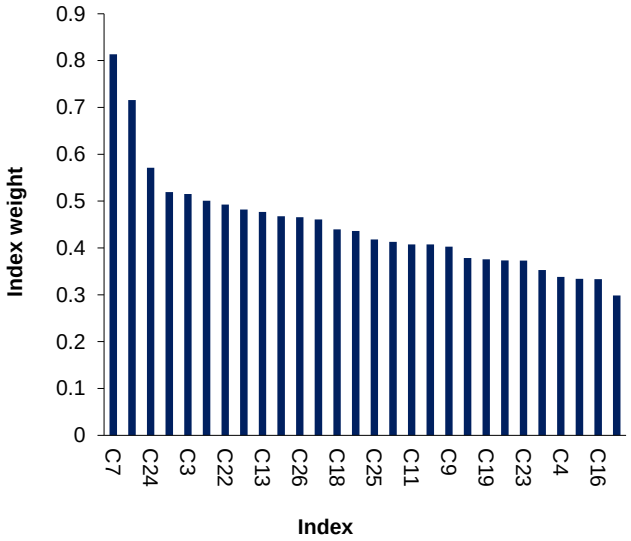


Fig. 1. The final score based on the grey relational ranking according to the experts' opinions.

The opinions of the experts indicate that the agricultural sector and its development in the case region, although it has been of particular importance, have not been given attention. Their reasons show that taxes on this sector can help development if done purposefully. This lever should be done with sufficient attention and precision. Also, according to the opinions of these experts in this group, agricultural research can effectively help the development of the agricultural sector. In the case region, despite the very high capacity of agricultural products, effective research can contribute significantly to development. The comparison of the infrastructural services and the increase in agriculture sustainability in economic, social, and environmental dimensions in terms of the villages covered by the cooperatives shows that the villages that have been provided with more agricultural infrastructure by the production cooperatives are more sustainable economically and socially. Providing agricultural infrastructural services to the villages covered is more related to expertise and technological support than to the cooperatives and their members because the implementation of infrastructural operations for agricultural development needs a huge financial budget, which is impossible to be supplied by production cooperatives. If the government continues to provide poor support, the cooperatives will be reliant on the government for a longer time and will become a governmental enterprise to meet the service needs of the farmers in the long run. This is, therefore, recommended to be considered in plans and policies. It is, in general, recommended to include training courses on the principles and techniques of sustainable development-based management and action in all academic and on-the-job courses for all national and provincial managers and experts.

3.2. Results from farmers' group

Sustainable development is the management and maintenance of natural resources and the direction of changes and administrative structure, to ensure the continuous supply of human needs and the satisfaction of the present and future generations. Such sustainable development in agriculture, forestry, and livestock sectors is associated with the protection of land, water, and plant and animal genetic resources, does not because environmental degradation uses appropriate technology, is economically viable and sustainable, and is socially acceptable. Therefore, the environment for appropriate policy-making is a powerful government sector, the participation of farmers' groups, and the existence of resource-protecting technologies. In this context, the duty of the government is to create a suitable institutional environment for accepting and implementing appropriate mechanisms and strategies for the sustainable agricultural development of the province. The final results of the grey technique based on the experts'

opinions showed that C7 was ranked the top with a final score of 0.8134. The second rank was assigned to C17 with a score of 0.71. C24 and C12 gained scores of 0.571 and 0.519 and were ranked the next, respectively. The lowest ranks were assigned to C6, C16, and C28 with scores of 0.334, 0.333, and 0.298, respectively. Based on the farmers' opinions, C17 and C7 were ranked first and second with final scores of 0.722 and 0.576, respectively. The third and fourth ranks based on the farmers' opinions were assigned to C10 and C14 with scores of 0.554 and 0.545, respectively. The lowest ranks were for C8, C6, and C28 with scores of 0.383, 0.369, and 0.327, respectively. The results showed that two options are given high priority based on both categories of expert experts. Based on these results, these two important indicators should be re-examined. Improving the financial situation in the agricultural sector can be one of the solutions for the development of the agricultural sector and increasing the agricultural income of the region. According to the obtained information, one of the problems and problems of the agricultural sector in the province is the lack of income of farmers, which can be helped in this way. On the other hand, collaborative processes were also given high priority. To improve this situation, help can be obtained from agricultural cooperatives and agricultural funds in the province. Agricultural cooperatives in Sistan and Baluchestan have a long history, but they do not function properly and should be taken into account by the authorities.

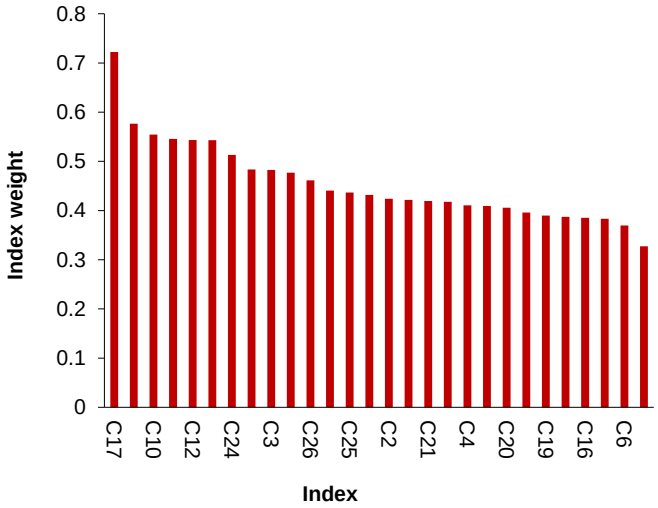


Fig. 2. The final score based on the grey relational ranking according to the experts' opinions.

Effective measures by adopting effective mechanisms for implementing the proposed policies within the known strategies can, in the current conditions, guide the province agriculture on the path of sustainability with a sustainable approach and provide conditions for an optimal win-win in the province for adopting strategies and using the strengths and opportunities of the internal and external environment for the goal of sustainable agricultural development with a dynamic and sustainable approach. In this framework, if the optimal conditions are realized, agricultural development in the province can be fueled by the development of investment and financial and credit institutions and the improvement of the tax and market system in the economic dimension, by the empowerment of the agricultural workforce and knowledge development, technologies and innovations, and determining ownership and legal institutions in the social dimension, and by the conservation and management of basic resources in the environmental dimension. In the meantime, cooperatives have an important impact on increasing sustainability in the social field. Also, extension and educational courses will increase farmers' awareness and allow them to share information. Evidently, informed farmers are more successful in increasing production incentives and participation and adhering to the principles of sustainable agriculture, which needs special attention.

4. Conclusions

It seems necessary to establish an ultra-ministerial structure for coordinating measures for sustainable development. Media need to publicize the concepts and principles of sustainable development and make people and civil institutions request adherence to the principles of sustainable agricultural development. It is proposed to conduct extensive in-depth research in rural and agricultural areas to understand, collect, and analyze the local experience and indigenous knowledge for the sustainable development of habitats. Then, extensive educational courses should be designed for other rural areas based on the role of rural people or the owners of indigenous knowledge as facilitators or trainers to motivate and promote the integration of indigenous knowledge and cooperative approaches in development plans. It is recommended to provide governmental and educational support, such as paying subsidies, granting long-term loans, introducing successful villages, and constructing extension and educational research centers for advancing, strengthening, and promoting the production of organic crops and the consumption of safe food. It is crucially important to diversify rural economic activities by emphasizing non-agricultural economic activities in addition to agricultural ones, such as crop processing, launching small businesses, ecotourism, handicrafts, and launching local bazaars.

Author Contributions

Ali Sardar Shahraki: Conceptualization, investigation, methodology, and writing-original draft.
Mahdi Safdari: Supervision, validation, review and editing.
Ebrahim HamidZadeh: Investigation, analysis.
Mawladad Khairi: Review and editing.

Conflict of Interest

The authors declare no competing interests and non-financial competing interests.

Data Availability Statement

The datasets used and/or analyzed during the current study will be made on reasonable request.

Acknowledgement

The authors would like to thank the Jihad-e Keshavarzi Complex for providing the required data and information.

References

Bahrami, A. (2019) 'The role of conservation village systems in sustainable agricultural and rural development', *Journal of Rural Development Strategies*, 2, pp. 181-188. doi: https://doi.org/10.22048/rdsj.2020.187385.1799

Moslemi, B., Hashmitabar, M. and Sardar Shahraki, A. (2021) 'Risk communication and acceptance of new inputs in agriculture; Case study of Saifi Karan of Kerman province', *Agricultural Economics Research,* 13, pp. 25-42. dor: 20.1001.1.20086407.1400.13.2.2.3

Ebrahimzadeh, I. (2009) 'Analysis of the recent droughts and lack of water in Hamoon Lake on Sistan economic functions', *Iran Water Resources Research*, 5, pp. 71-76. Available at: https://www.iwrr.ir/article_15761.html?lang=en (Accessed date: 17 January 2024).

Khairi, M., Safdari, M. and Sardar Shahraki, A. (2022) 'An integrated investigation into the socioeconomic factors threatening crop marketing: A comparative study on Faryab province of Afghanistan and the Sistan Region of Iran', *Environmental Energy and Economic Research*, 6, pp. 1-20. doi: https://doi.org/10.22097/eeer.2022.276998.1188

AliAhmadi, N. *et al.* (2021) 'Forecasting the best time series model of climatic parameters in Hirmand catchment, *Journal of Climate Research*', 47, pp. 83-100. Available at: https://clima.irimo.ir/article_132144.html?lang=en (Accessed date: 2 January 2024).

Rezaei, B., Naderi, N. and Rostami, S. (2018) 'Development of green entrepreneurship to fuel sustainable development: An emphasis on organic farming, safe crop, and precision agriculture', *Journal of Studies in Entrepreneurship and Sustainable Agricultural Development*, 5, pp. 1-15. Available at: https://sid.ir/paper/109150/fa (Accessed date: 10 December 2024).

Sardar Shahraki, A., Shahraki, J. and Hashemi Monfared, SA. (2016) 'Ranking and level of development according to the agricultural indices, Case study: Sistan Region, *International Journal of Agricultural Management and Development (IJAMAD)*, 6, pp. 93-100. Available at: https://sanad.iau.ir/ar/Journal/ijamad/Article/1037631/FullText (Accessed date: 1 March 2024).

Sardar Shahraki, A., Shahraki, J. and Hashemi Monfared S.A. (2018) 'An integrated Fuzzy multi-criteria decision-making method

combined with the WEAP model for prioritizing agricultural development, Case study: Hirmand Catchment, *Ecopersia*, 6, pp, 205-214. Available at: https://ecopersia.modares.ac.ir/browse.php?a_id=16023&sid=24&slc_lang=fa (Accessed date: 21 November 2024).

Sardar Shahraki, A., Mohhamad Ghasemi, M. (2023). 'An assessment of the economic effects of drought in the Hirmand basin in the east of Iran: The application of the decision support system (DSS) approach', *Journal of Applied Research in Water and Wastewater*, 10(1), pp. 15-19. doi: https://doi.org/10.22126/arww.2023.7728.1248

Kiani Ghalehsard, S. *et al.* (2021) 'Assessment of the impacts of climate change and variability on water resources and use, food security, and economic welfare in Iran', *Environment, Development and Sustainability*, 23, pp, 14666-14682. Available at: https://link.springer.com/article/10.1007/s10668-021-01263-w (Accessed date: 26 February 2024).

Taghavifard, M. and Malek, A. (2011) 'Using grey decision making approach to ranking key performance indicators (kpi) and increase effectiveness of strategic plans', *Journal of Industrial Management Studies*, 9, pp. 135-165. Available at: https://jims.atu.ac.ir/article_4516.html?lang=en (Accessed date: 10 September 2024).